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AN AUTOMATED RESERVATION SYSTEM FOR THE BWCA WILDERNESS

By

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ABSTRACT

A visitor distribution system for controlling recreational use was established in the BWCA Wilderness in 1976 because existing use in some portions of the area was exceeding acceptable limits. The present system controls use by applying entry quotas to most of the entry points into this wilderness. The manual methods used to handle reservations and issue permits at five Ranger District offices and the 90 commercial permit stations do not provide the prompt, accurate information that the public deserves. The use of a minicomputer and custom designed programming is expected to improve service to the public. It will allow managers to monitor use during the season and resolve problems as they develop. The computer linkage with the Ranger Districts will also create other new management opportunities.

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I. INTRODUCTION

The Boundary Waters Canoe Area Wilderness (BWCA) is a 1,086,914 acre unit of the National Wilderness Preservation System. It is part of the Superior National Forest in northern Minnesota and host to well over 1,000,000 visitor days of recreational use each year.

Recreational use has been a major management objective for the area since 1926, when the Forest Service first placed it under the administrative protection of regulation U-3 of the Secretary of Agriculture. Numerous laws and regulations have since then given the BWCA additional protection from conflicting uses and have very specifically defined its management. The latest of these is the 1978 BWCA Wilderness Act (P.L. 95-495), which prohibited all logging, discouraged mining, and severely restricted the use of snowmobiles and motorboats. This Act terminated the use of motorboats on all but a few of the BWCA's 1,175 lakes and mandated the establishment of motorboat quotas. The quotas are to limit motor use on the remaining motor lakes to levels which do not exceed those which existed on each of these lakes in 1976, 1977, and 1978.

Management of the large volume of recreational use was complex even before the 1978 Act. Camping and campfires were already limited to the 2,200 designated sites and quotas kept the number of overnight campers in balance with available campsites. Each of 84 entry points had a daily quota, adjusted for the season, and expanded for

the percentage of no-shows (people who reserved permits but did not use them). Complicated wall charts and file systems are now only partially successful in coping with the reservations, changes, cancellations, no-shows, and overbooking provisions needed to process the 40,000 permits each year. A portion of the control chart for the Kawishiwi District, busiest of the five BWCA districts, is attached as Appendix D. Some of the shortcomings of the system are:

1. Each of the five BWCA districts can verify reservations only for its own entry points. Some visitors have to contact several Forest Service offices before succeeding with a reservation or permit.
2. Use data is not available until five months after close of the season. Data is obtained by keypunching the permits at the end of the year, too late to be included in the Recreation Information Management (RIM) reports for that year.
3. The manual chart and file system occasionally fails to limit entries to the predetermined quota. These irregularities do not become visible until the end of the season when the key-punched and computer analyzed data becomes available.
4. Some use related problems within the BWCA are not detected before they bring complaints from the public or cause damage to the wilderness resource.
5. Operating cost of the existing manual system is higher than that of an automated system (Yurich 1980).

6. The manual system is more prone to manipulation by experienced commercial users such as outfitters and resort guides. This leads to overuse on favorite travel routes.

These six points clearly indicate that the present system needs revision or replacement. The goal of the Automated Reservation System (ARS) project is to devise a better procedure which would correct the problems noted above.

II. PREVIOUS APPLICATIONS

The application of computer technology to wilderness management has been slow, much slower than its use in other fields of management. The main reasons for this lag have been: (1) the high initial cost of the hardware and (2) the relatively minor technical demands of most wildernesses. There are no computer controlled (on-line) wilderness entry systems in operation today.

Recent increases in wilderness use are, however, beginning to change management thinking. There is a need for more complex techniques to protect the wilderness resource while allowing optimum levels of recreational use. The Superior National Forest implemented a permit system for the BWCA in 1966. The primary purpose of the permit requirement was to assure an informational contact with the visitor before he entered the BWCA, thus giving the Forest Service the opportunity to inform him about proper use of the area. The permit system also became the basis for the first reliable large scale data bank on wilderness use.

The permit data was key-punched at the end of the season, then analyzed and compiled by computer (Lime 1973). A similar permit requirement was also implemented in 17 National Forest Wildernesses in California in 1971 and a computer program developed for data analysis in 1972 (Elsner 1972).

Recreational use in several National Forest wildernesses in California, as well as in the BWCA, has prompted management to impose quotas. Entry point quotas were applied in the San Gorgonio and the San Jacinto Wildernesses in 1973 (Stankey 1979), the John Muir in 1974 (Ernie DeGraff 1982), and in 1976 in the BWCA (Hulbert 1977). The BWCA quotas were based on a "travel model," a computer program which correlated the expected occupancy of interior campsites with the number of groups entering from the various entry points (Gorman 1972).

In late 1977 the Superior National Forest began exploring possibilities for automation of BWCA reservations and permits.

III. ALTERNATIVES FOR THE BWCA WILDERNESS

A. THE MANUAL SYSTEM.

Permits have been written manually for the BWCA since 1966. Overnight quotas and reservations have been handled manually since 1976. Motor quotas were added in 1979. The present system actually consists of five independent subsystems, one for each of the five ranger districts. Each district has information and control on its own area only. This limits public service capability and also delays administrative response to wilderness management problems or opportunities. Continuation of the manual system would mean accepting these limitations as well as its somewhat higher operating costs. Even the simplest acceptable automated system would save 14 person years of work over a five year period (Yurich 1980).

B. TIME SHARING ON A NON-OWNED COMPUTER.

Three options for time sharing on large computers owned by someone else are possible:

1. The U.S.D.A. Computer Center.

   This large facility in Fort Collins, Colorado is best described as low cost to the user, sometimes hard to reach by phone due to an overload of work, and subject to occasional breakdown. It is well suited to one shot projects which require large capacity hardware. It requires a new telephone contact

with Fort Collins each time work is to be done. Telephone costs would be prohibitive if it were to be used as an on-line service capable of immediate response to an inquiry. Year end use information, taken from BWCA permits, is now compiled by this facility with acceptable but not outstanding results. Interpretation of computer programs and other voice communications with the center are sometimes confusing due to the large staff which may work interchangably on any given job.

2. Local University Computer.

The University of Minnesota in Duluth agreed to make its computer available for a nominal fee. Its presently unused capacity is estimated to be adequate for ARS requirements. But this can not be positively established until an actual ARS program is compiled and tried.

The most serious shortcoming of this option is that only one terminal port would be available for our use (Soderberg 1979).

3. Commercial Computer Center.

Sharing time on a large commercial computer center is the fastest way of getting a new system into operation. The Superior National Forest received a proposal from a major computer firm to automate the permit system in less than four months time. This rapid start up time may actually be possible since all of the hardware, except the terminals and telephone connections, is already operational. Another major advantage of the system is ready availability of custom programming services from the same

firm on very short order. Disadvantages of this option are the large recurring annual charge for use of the hardware and the specific nature of the software program, rendering it unuseable on any other hardware.

C. PURCHASE OWN MINI/MICROCOMPUTERS.

1. Central Minicomputer with Terminals.

The system would consist of a minicomputer in a location where programmers and maintenance personnel would be readily available (in this case Duluth). Dedicated telephone lines would connect the five district terminals to the computer. It would be an on-line system wholly assigned to BWCA reservation functions, unless additionnal capacity remained for other work. The video display terminals would have no independent capability to store or process information.

The primary advantage of purchasing, rather than time-sharing the hardware, is the total control and availability which only ownership can provide. The initial cost would be high but the five year operating cost would be lower than the present manual system. Disadvantages are the long lead times required to develop specifications and obtain approvals. If both hardware and software are to be purchased by contract, even if from the same source, the specifications must be explicitly detailed and carefully matched, one with the other. About three years would be required between the decision to automate and installation of

the system. Cost of the dedicated telephone lines would be the one large recurring cost peculiar to this system.

2. Microcomputer Network with Periodic Update.

This alternative is similar to the previously described minicomputer system except:

a. The Kawishiwi District, busiest of the five BWCA districts, would have a microcomputer (smaller than a minicomputer) of sufficient capacity to handle its own entry point quotas on a day-to-day basis. It would also have an adequate storage capacity to serve as a backup or recall system for each of the other four BWCA districts. The four districts would have microcomputers with enough capacity to handle only their own entry points.

b. Communication between districts would be by commercial telephone with another district controlling that entry point. This method of communication would cost $10-15,000 per year less than the dedicated line method. It would also mean delays in responding to information requests from the public as well as some delay in getting administrative information.

c. Updating of the Kawishiwi District microcomputer by the other districts would be done by commercial telephone line each day, during slack periods.

d. Annual and periodic reports would be prepared by the Kawishiwi District computer immediately after an update from the other districts.

This proposal would improve public service above that which is possible with the present manual method, but would fall short of the on-line minicomputer system. The same would be true of the accuracy and timeliness of its use data.

IV. THE SELECTED SYSTEM

A. THE SELECTION PROCESS.

The search for a better system was not a single unified process but a series of studies spanning about four years.

The decision to follow the minicomputer purchase option (alternative C.1. in section III of this report) was made jointly by the Forest (Anderson, April 9, 1980) and the Regional Office Technical Staff (Yurich, October 9, 1980). The table which follows shows the criteria used to evaluate the comparative merits of each alternative. A rating of 1 indicates the system which would produce the best results, a 6 the least desirable.

Alternatives

Evaluation Criteria	A Existing Manual System	B1 U.S.D.A. Computer Center	B2 Univ. Of Minn. Computer	B3 Commercial Computer Center	C1 Mini-Computer +Terminals	C2 Micro-Computer Network
Public Service	6	4	5	2	1	3
Use Data Availability	6	4	5	2	1	3
Additional Management Benefits	6	3	4	5	1	2
5-Year Cost [1/]	5	1	2	6	4	3
Breakdown Frequency	4	6	5	1	2	3
Software Availability	-	4	5	1	2	3
Development and Approval Time	1	2	4	3	6	5

[1/] Actual costs are not cited here because data from the several cost and feasibility studies are not directly comparable. Chris Hsieh and William Tisler of the Regional Office should be credited with the development of all technical and most of the cost information (Hsieh 1980).

The minicomputer option was chosen because:

1. Its public service potential is the best of any of the alternatives. This on-line system, connecting the Forest Supervisor's office and all five BWCA districts will be able to give immediate response to a query directed at any of the six locations. Alternative B3 would have been a close second.

2. Use data will be available at any time to each of the six offices with terminals. Alternative B3 would have been a close second.

3. The additional management benefits of this system far exceed those of any of the other alternatives. In addition to the reservation process, the system can print wilderness permits, prepare use reports during the season and at the end of the year. It can record use by travel zones as it takes place. It can search for an individual travel itinerary for the purpose of locating an individual in case of emergency. The unused capacity of this hardware will be available to do word processing tasks for any of the six offices, transmit electronic mail, or perform engineering, timber management, or other tasks which require the services of a computer.

4. The five year cost is less than that of the B3 alternative, its nearest competitor in performance. A crucial item here is the cost of dedicated telephone lines. A separate line to each of the dis-tricts would cost about $6,000 per year, a total of $30,000 per year. This cost will be reduced by inserting a

"Multiplexer" into the system and transmitting the signals from several districts over a common line. This will reduce the telephone costs to $16,000 per year.

5. The breakdown potential is lower than all but one of the other alternatives.

6. Software is to be purchased from the same contractor and will be custom designed.

7. The development time requirement is listed here only as a point of consideration for future planning. It was not a decision item.

B. THE AUTOMATED RESERVATION SYSTEM

Both hardware and software are to be supplied to the Forest by the Exacta Corporation of Milwaukee, WI, a distributor for Texas Instruments Corporation hardware.

The ARS hardware centers around a model TI 990/10 mini-computer with a disc-based commercial operating system and 256K bytes of memory. Two TI 911 video display terminals and a model LP 300 printer are planned for the Supervisor's Office. Each of the five district offices will have a TI 940 terminal. The complete hardware, including that needed for word processing, is listed in Appendix C.

The software consists of all functions needed to:

1. Load the system with the appropriate entry points, travel zones, overnight quotas and motor quotas.
2. Inquire for availability of a permit.
3. Reserve a permit and print a confirmation or rejection letter.
4. Search for a previously made reservation and make changes.
5. Keep account for collection of the $5.00 reservation fee (some cooperators will have deposit accounts for making phone reservations).
6. Print summaries of reservations made to date.
7. Print a permit.
8. Print summaries of permits issued by various categories (entry point, exit point, mode of travel, type of visit, origin of party leader, etc.).

9. Search for a permit by name of the party leader or by serial number. The permit information, once located, also shows the individuals route of travel and is particularly useful for locating people in cases of emergency.

10. Integrate the three sets of entry point quotas which apply to the BWCA:

a. Overnight Camping Quotas.

The quotas are based on the total capacity of all the campsites in the BWCA and apply to all campers, regardless of their mode of travel. A daily limit is placed on the number of parties which may enter from each of the 87 presently managed entry points to the area. Party size is limited to 10 persons or less.

b. Motorboat Overnight Quotas.

Mandated by the 1978 BWCA Wilderness Act, these quotas apply a weekly entry limit to the number of overnight motorboat groups which may enter from the 11 entry points where motor groups are allowed. For overnight motor groups the ARS system must check through two quota requirements: (1) the availability of a permit under the overnight camping quotas and (2) the overnight motorboat quotas. In addition, the ARS program has a built in provision for allowing use of unused overnight motor permits from the previous week and for borrowing overnight motor permits from the week ahead.

c. Motorboat Day Use Quotas.

These are weekly quotas which limit day use of motorboats on 13 lakes and have no relationship to any other set of quotas. Like the motorboat overnight quotas, they also are mandated by the 1978 Act and are administered with provisions for carryover of unused permits from the previous week and borrowing of permits from the week ahead.

All ARS programs will be written in Texas Instruments extended Cobol, although the hardware would also support Pascal, Fortran, Basic, or Tiform.

V. LOOKING AHEAD

The ARS is expected to open up a number of new management opportunities. A single data bank, able to record, analyze, and recite back the entire recreational use situation while it is actually happening in the wilderness, will be more than just an improvement. It will be a whole new series of opportunities. ARS will for the first time provide a means to monitor wilderness use in a real-time situation and help prevent rather than repair damage.

Some of the already visible benefits which the ARS can be expected to bring to wilderness management are:

1. Up-to-the-minute use data will be available at any time. Use by mode of travel, size of parties, and type of use are but a few examples.

2. Zone-by-zone monitoring of recreation use will be possible to a limited degree in 1982. Campsite occupancy for each of the 50 BWCA travel zones can be determined for several days ahead by analyzing recently issued permits and the next day's reservation data. This type of current analysis can identify entry points where visitor information personnel can be used to best advantage and may point out interior travel zones where unusual crowding can be anticipated. At some future time it may be possible to allow a daily analysis of travel zone occupancy to set entry point quotas. This would be a real-time travel meter which could

well replace the travel model for determining daily limits for recreational use.

3. Inventories of various wilderness elements:

   a. Campsites which are now on Code-a-site type cards.

   b. Lake inventories by name, location, fishing potential, sensitivity to use, and other characteristics.

   c. Structures such as dams, administrative facilities, reserved rights, cabins, etc.

   d. Vegetative conditions by Ecological Land Type. The inventory could by expanded to establish base lines and monitor for changes within predetermined limits of acceptable change. This would agree with the direction given in III C.4.d. of the BWCA Act Implementation Plan (Plan to Implement the BWCA Wilderness Act 1981).

4. A recreation opportunity guide or user education program could easily be accomodated on this system. Additional video display terminals at the Voyager Visitor Center, the Cook Visitor Center, or the Ranger Station in Grand Marais could bring useful information to BWCA visitors at relatively small additional cost.

VI. SUMMARY

The Superior National Forest, recognizing that its manual system for processing BWCA Wilderness permits was becoming inadequate, reviewed a number of alternatives:

A. Continue the manual system.

B. Share time on someone elses computer.

   1. The U.S.D.A. Computer Center.

   2. A local University computer.

   3. Large commercial computer center.

C. Purchase own Mini/microcomputer.

   1. A minicomputer with a terminal on each district.

   2. A network of microcomputers, one on each district.

After an examination of each, the Forest chose to follow the mini-computer purchase option (C.1.) as the most opportune. It will provide the best public service, the most reliable data, and the most dynamic wilderness management at less cost than the present manual process.

The Forest Service is now in the process of purchasing the required hardware and software. The initial cost, including training for operators and maintenance personnel, is about $117,000. Some of this cost is attributable to functions other than wilderness, such as the word processing capability. The system is expected to be installed and fully operational for the 1982 summer season.

Recommendations to any wilderness manager considering conversion to an automated system are:

1. Start the planning process at least three years before the system is needed.
2. Get the help of the most competent electronics engineer available to you at the very beginning.
3. Define wilderness management needs and decide on the general type of system which would best meet your objectives.
4. Prepare a feasibility study jointly with your electronics engineer.
5. Request technical authorization from U.S.D.A. for the total cost of the project. Be sure the amount is adequate to cover inflation or the chance of an original underestimate.
6. When contract specifications are written for software, be very specific. Make sure the electronics engineer, a computer programmer and a wilderness manager are all fully involved in writing the specifications.
7. Allow for delays and provide an alternate system during the first operating season.
8. Be prepared for adjustments as the system design and programming develops. Some adjustments will be needed to correct unforeseen problems, others will produce additional benefits which were not visualized in the beginning.
9. Have patience!

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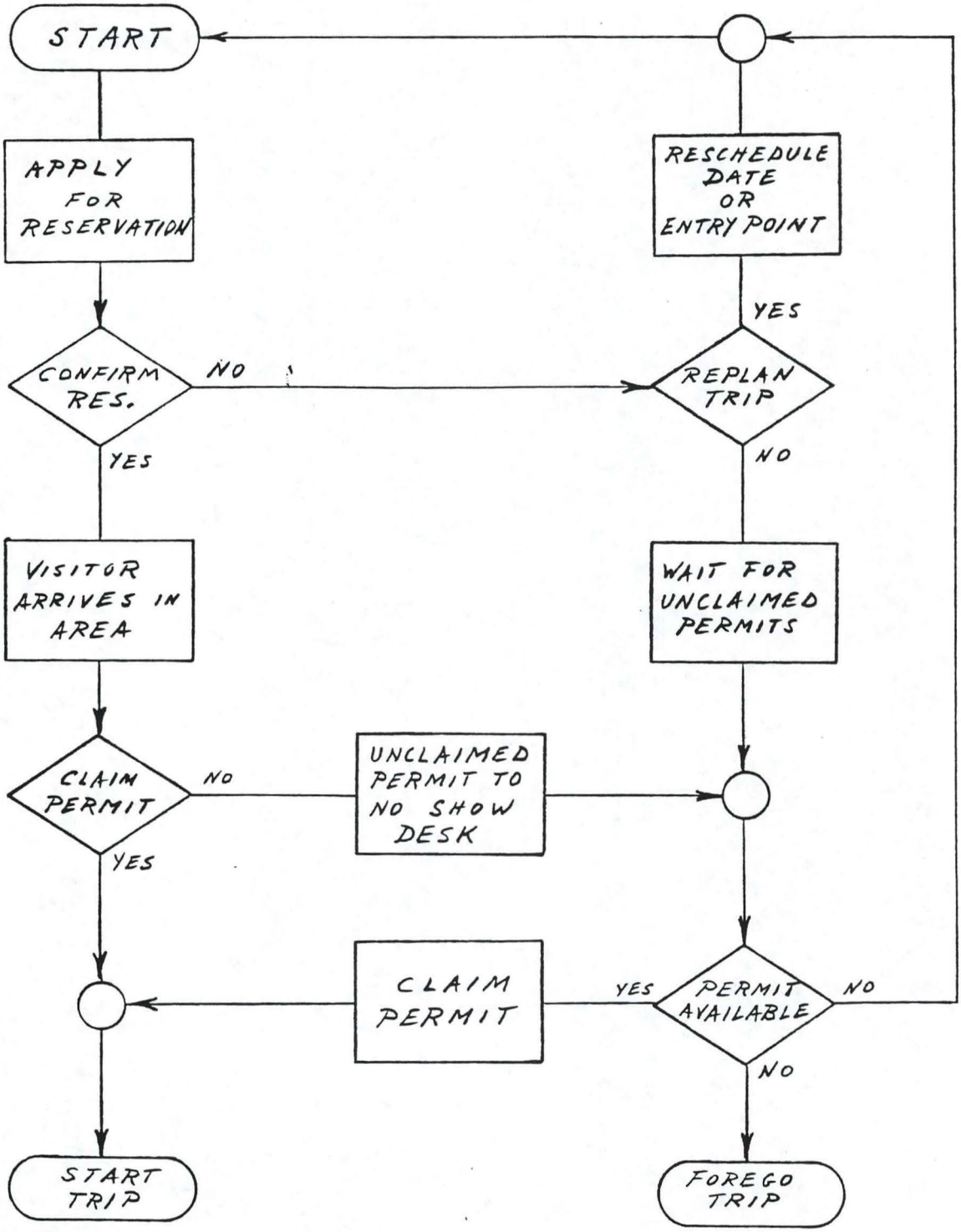
APPENDIX B

AUTOMATED RESERVATION SYSTEM

(BWCA WILDERNESS PERMITS)



APPENDIX C

The following items are to be procured under this contract in accordance with the attached schedule:

I. Automated Reservation System

ITEM	PRICING SCHEDULE LINE ITEM	COST
1. Model DS 990/7 Computer System Hardware		
a. 990/10 Computer	(Page 1, Line 4, 1-4)	$35,855.00
b. 2nd Console MDL 911	(2-2)	1,715.00
c. Remote Site Terminals MDL 940, five	(2-4)	13,400.00
d. UPS	(3-6)	1,200.00
e. 300 Lpm Printer MDL LP 300	(1-13)	9,555.00
f. Telecomm. Protocol Emulator, IBM 2780	(2-13)	3,450.00
SUBTOTAL		$65,175.00
2. Model DS 990/7 Computer System Software, Standard		
a. STD Software Operating System, DX10	(2-11)	850.00
b. STD Software Utilities	(2-12)	100.00
c. ✓ Costomized Software, ARS Software	(2-15)	19,950.00
SUBTOTAL		$20,900.00

I. Automated Recirculation System

ITEM	PRICING SCHEDULE LINE ITEM	COST
3. Support		
Documentations (2 Ship to Sup NF, 1 to Milw)		
a. Complete System Maintenance & Documentation, 3 Copies	(5-1) (5-2)	575.00 300.00
b. Complete System Operation & Maintenance & Documentation, 3 Copies	(5-3)	285.00
Diagnostics		
c. System & Major Component Self-Diagnostics Routines	(4-6)	1,875.00
Training		
d. Operation Training	(3-6)	300.00
e. Technician Factory Training	(4-14)	3,000.00
f. Installation, Acceptance Test Warranty	(3-6, revised 9-22)	1,925.00
g. Delivery, Insurance	(revised 9-22)	1,500.00
SUBTOTAL		$9,760.00
TOTAL - ARS		$95,835.00

II. Word Processing

ITEM	PRICING SCHEDULE LINE ITEM	COST
1. Hardware		
a. 128K Memory, Addition	(1-2)	$3,500.00
b. Additional T-C Module for 4 Local WP Terminal	(1-6)	N/C
SUBTOTAL		$3,500.00

II. Word Processing

	ITEM	PRICING SCHEDULE LINE ITEM	COST
2.	Software	(2-6)	$4,150.00
	SUBTOTAL		$4,150.00
3.	Support		
	a. Installation, Acceptance Test Warranty	(To be 2-9 Modified)	N/C
	b. System Operators Training	(3-6)	600.00
	c. Complete System Maintenance & DOC, 3 copies	(4-17)	200.00
	d. Operation & DOC Manual	(5-2)	300.00
	SUBTOTAL		$1,100.00
	TOTAL - WP		$8,750.00
	TOTAL WP & ARS		$104,585.00

III. Multiplexer Hardware

13 ACT CODE	14 DESCRIPTION	15 BUDGET OBJECT	16 ACC. LINE	17 QUANTITY	18 UNIT ISSUE	19 UNIT PRICE	20 AMOUNT
	MPM-1600/8 POLECAT MUX, 8 CH	3124	1	1	EA	2042.50	2042 5
	RPM-200, REMOTE MODEM (1 BACKUP)	3124	1	6	EA	895.00	5370 0
	MP-31, CONTROL TERMINAL	3124	1	1	EA	1577.00	1577 0
	202 S/T MR MODEM (1 BACKUP)	3124	1	7	EA	375.25	2626 7
	DE-1, ENCLOSURE FOR ABOVE	3124	1	7	EA	76.00	532 0
	C1-E-15, RPM/MPM TO MODEM	3124	1	6	EA	28.50	171 0
	CABLE C2-T-05, RPM TO TERMINAL CABLE	3124	1	5	EA	23.75	118 7